FDC-3B/C FLOPPY DISK CONTROLLER
INSTALLATION MANUAL
SECTION I

CONGRATULATIONS! You have selected the finest quality floppy disk controller upgrade kit available for your Model-III computer system at any price. In order that you may get the unit operating in the least amount of time, we recommend that you READ THROUGH THESE INSTRUCTIONS AT LEAST TWICE BEFORE PROCEEDING. At first you may think that this will add considerably to the time necessary to complete the installation, but we have found that it substantially reduces the potential for making an error, thereby speeding up the process. MICRO MAINFRAME **presumes that you have a certain degree of mechanical skill and a certain degree of computer literacy in order to complete this installation.** If you do not possess these skills, you should probably have someone who does to install this disk controller. While the mechanical skills required are minimal, the knowledge of computer circuitry is required in order to troubleshoot the system if it does not work.

If you have not purchased 32K of additional memory, we advise you to make this purchase prior to commencing with the installation. A DISK SYSTEM REQUIRES A MINIMUM OF 32K RAM MEMORY AND THE LEVEL-II ROM SET. If you do not have a Level-II TRS-80, it will not be capable of disk operation without the addition of a Level-II ROM set. You will have to take the Model-III to Radio Shack for the Level-II installation. We advise that you do this prior breaking the seal on the computer.

While it is true that your TRS-80 will perform disk operation with less than 32K of user RAM, you should consider upgrading to a full 48K of RAM. Memory prices have fallen considerably over the last several months and it is poor economy to save $15 and not have the full amount of RAM. Please make the tests described in Paragraph 0.0 below before attempting to install the memory chips.

Before proceeding with the installation, you should also perform the following tests described in Paragraph 0.0 below to your Model-III in order to determine if there is some problem that has heretofore remained undetected. Remember, if there is something wrong with your computer, and it does not have Tandy drives and disk controller installed, Tandy is not obligated to repair the unit. It is to your advantage to have performed this series of tests prior to installing the MICRO MAINFRAME controller, so let us begin.

0.0 TEST PROCEDURE

1. Turn the unit on and enter the cassette mode. Answer the prompts with <ENTER> and type PRINT MEM. If you have a 16K machine, you should have 15314 printed on the screen. If you have a 32K or 48K machine, you will have either 31698, or 48082 respectively.
2. If you have a printer, verify that the parallel printer port is working properly by typing in a small BASIC program and then type LLIST. Don't forget to connect the printer before attempting this test. If the printer lists properly then you may safely assume that the printer port is functioning properly.
3. Verify proper operation of the RS-232 serial port.
4. Verify proper operation of any devices or modifications you may have made previously to the machine.
5. Upon completion of the items listed above, you are now ready to proceed with the installation. UNPLUG THE COMPUTER AT THIS TIME TO PREVENT SERIOUS SHOCK OR POTENTIAL DEATH! YOU ARE ALSO CAUTIONED NOT TO TOUCH THE LARGE WIRE OR ANY PORTION OF THE CRT; BOTH HAVE 15,000 VOLTS ON THEM, WHICH CAN BE PRESENT ON THE CRT FOR SEVERAL MINUTES AFTER POWER HAS BEEN REMOVED, SO TREAT BOTH WITH ALL DUE RESPECT!

1.0 UNPACKING YOUR FDC-3B/C KIT

The following list is a complete inventory of the component parts included with each FDC-3B/C and accessories kit. Please examine the package carefully for any shipping damage and to make certain that you have received a complete set of parts. IF THERE HAS BEEN ANY DAMAGE BY THE CARRIER WHILE ENROUTE, YOU MUST NOTIFY THE CARRIER AND YOUR DEALER WITHIN (3) DAYS OF RECEIPT OF THE MERCHANDISE TO ESTABLISH YOUR CLAIM. Each kit has been checked twice to assure that all all parts have been included. IF ANY PARTS ARE MISSING, YOU MUST NOTIFY THE DEALER FROM WHOM YOU PURCHASED THE KIT WITHIN (3) DAYS OF RECEIPT REGARDING THE SHORTAGE.

IK-3 INSTALLATION KIT PARTS INVENTORY

1. Mounting Brackets (2 ea, both are the same length)
2. 34 position ANSI standard* drive cable (2 drive positions)
3. 8-32 x 3/8" pan head screws (4 ea)
4. 8-32 flat washers (4 ea)
5. 6-32 x 3/8" pan head screws (4 ea)
6. Disk Drive power cables (2 ea)
7. Packet of Disk Drive Mounting screws (4 ea)
8. Plastic Ty-Wrap (TM) for power supply mounting (2 ea)
9. Controller power cable (1 ea)
10. 20 conductor, 4.5" long flat ribbon cable (1 ea)
11. 8 conductor, 10" long ribbon cable (1 ea)
12. Drive controller board (if purchased, 1 ea)
13. Switching power supply (if purchased, 1 ea)

* ANSI standard drive cables select the drive using the dip shunts on the drives instead of removing pins from the cable as Tandy does for drive selection. If you must use a Tandy cable, you will have to remove the pins to select the proper drive the same as Tandy does.

2.0 MODEL-III DISASSEMBLY PROCEDURE

2.1 Before proceeding, you must REMOVE ALL CABLES attached to the bottom of the Model-III (eg. printer, etc.). The easiest way to accomplish this is to place a soft towel or other material on the work surface and invert the Model-III on top of it. You will need both a SLOT and a PHILLIPS screwdriver to perform the installation. Using the PHILLIPS screwdriver, remove the 10 screws from the bottom of the case (removal of one of the rear corner screws will require that you break the seal that Tandy has placed on the bottom of the machine). BREAKING THIS SEAL MAY VOID YOUR TANDY WARRANTY! Please note that some of the screws are of different types and lengths. It is a good idea to tape similar screws together with masking tape, and write on the tape the location that they came from.

2.2 You should now restore the computer to the upright position, taking great care to hold together the top and bottom parts with your hands while turning the unit over. You should now remove the screw located at the top rear apron of the computer enclosure. MMF RECOMMENDS THE USE OF PROTECTIVE GOGGLES WHILE REMOVING AND REINSTALLING THE TOP OF THE MODEL-III COMPUTER.

2.3 WHILE EXERCISING EXTREME CAUTION, you should now remove the top of the enclosure from the base plate by lifting the top enclosure slightly TOWARD YOU AND OFF the Model-III computer. NOTE WELL: IT IS POSSIBLE TO BREAK THE CRT (PICTURE TUBE) IF THE NECK OF THE CRT TUBE HANGS ON THE CHASSIS OR CABLING (this frequently happens), so some extra precaution is applicable here. The CRT tube could implode (similar to explode) and do great damage to you especially if you were not wearing protective goggles. You may now unplug the cables going to the video board (left side of the cover component of the case.

Set the top cover aside and to the left of the Model-III before you attempt to remove the power cables to the video board. You may now remove the video plug and ground cable from the video unit. After you have accomplished this, you may move the top of the machine to any convenient, out of the way place.

3.0 CPU BOARD REMOVAL - REFER TO FIGURE 9-1

3.1 Rotate the Model-III so that you are facing the rear of the computer case (the part we want is inside the metal chassis that is now visible).

1. Remove the metal chassis by removing the 4 sheet metal screws you see around the top and sides of the cover. Please note the location of all ground straps during this step so that they may be properly replaced during reassembly. Your RFI shielding must have all ground straps secure to assure that the original FCC noise specifications will be retained. **THE USER IS RESPONSIBLE FOR ALL VIOLATIONS OF THE FCC REGULATIONS IF THIS SHIELD IS LEFT OFF!** If you have a early version Model-III, you will not have this shield (IT IS NOT REQUIRED FOR THIS VERSION OF THE MODEL-III) and will not have to perform STEP 1. You must instead remove a small metal bracket which is secured by two sheet metal screws into the vertical metal chassis in order to remove the CPU PC board. Please refer to **FIGURE 9-2** for the location of this bracket.

2. If you have not installed 32K of additional RAM, you should do so at this time, and you should then make certain that there are no problems with the memory before continuing with the controller installation.

   a. Make certain the AC power cord is disconnected.

   b. Refer to **FIGURES 9-1** and **9-3** to locate the place to install your memory.

   c. Insert each memory chip into the socket as per **FIGURES 9-1** and **9-3**. Make certain that each chip seats properly and does not have any pins bent under the chip during installation.

   d. After completion of the previous step, you may reconnect the AC power and test for correct installation by performing step 1 of Paragraph 0.0. Don't forget to reconnect the cables from the CPU to the Video Monitor if you have already removed them. If the operation was successful, the TRS-80 should reply **48082** to your query **?MEM.**

3. Remove the power and video connectors in the upper right corner of the CPU PC board. Refer to **FIGURE 9-1** for the location of these connectors.

4. Remove the 20 pin jumper cable going from the RS-232 board (if installed). Refer to **FIGURE 9-1** for the location of this connector.

5. Remove the keyboard cable located on the very left side of the CPU PC board in the center of the board (see **FIGURE 9-1**). Pull the connector off straight toward you so as not to bend or damage any of the connector pins.

6. Remove the cassette port connector located just below the keyboard connector on the CPU PC board (see **FIGURE 9-1**).

3.2 Remove the screws that hold the CPU PC board to the vertical metal chassis. In the current version Model-III, there are seven (7) sheet metal screws holding the CPU PC board to the chassis.

3.3 If you have one of the early version Model-III computers, you will have a combination of screws and plastic spacers holding the CPU board to the chassis. The plastic spacers may be released by squeezing the connector at the top to release the detent holding the board in place.

NOTE:

While you are removing the CPU PC board, carefully examine between each screw and the Metal Chassis to determine whether or not there is a small flat plastic insulator the PC board and the Metal Chassis. Please refer to FIGURE 9-1 for the location of these spacers. SOME VERSIONS OF THE MODEL-III DO NOT HAVE THESE SPACERS. Make certain that you correctly reinstall the spacers during reassembly of the computer after completion of the installation procedure if they were included with your Model-III. FAILURE TO REPLACE THESE SPACERS IN THE PROPER LOCATIONS WILL RESULT IN SHORTING OUT SOME OF THE DISK CONTROLLER INTERFACE CIRCUITRY, AND THE CONTROLLER MAY NOT WORK. Put these screws and spacers in a safe place so that you will not lose them.

4.0 FDC-3B/C PCB INSTALLATION

PLEASE REFER TO FIGURE 9-4 FOR THE FOLLOWING STEPS.

4.1 Remove the FDC-3B/C PC board from the protective packaging. Check the board at this time for any obvious problems (such as broken capacitors, etc.).

4.2 Mount the FDC-3B/C PC board up against the metal spacers on the left side of the chassis that holds the CPU PC board. The component side of the board should be facing you and the lettering on the board should be right side up. Take the four (4) 6-32 x 3/8" pan head screws (supplied) and insert one into each of the two top mounting holes of the FDC-3B/C. DO NOT USE ANY METAL WASHERS ON EITHER SIDE OF THE FDC-3B/C PC BOARD. The bottom screws are slightly more difficult to install, as you will first have to insert your screwdriver through the holes provided in the metal chassis before you pick up the screw. Mate the screw to the screwdriver and install the bottom screws. A pair of tweezers or Long Nose Pliers will be handy here. Grasp the screw with the pliers and insert it through the holes in the FDC-3C PC board. While holding the screw with the pliers, insert the screwdriver through the hole in the metal bar at the bottom of the Model-III and screw the screw into the threaded metal spacer on the metal chassis.

PLEASE NOTE:

If yours is a early version Model-III and does not have the metal standoffs installed, you will have to obtain them locally or perhaps manufacture some. Richco Plastics makes a series of suitable components. These should be 1/4" high and should be attached to the chassis with 6-32 x 1/4" screws (2 required). The bottom of the FDC-3B/C PC board is affixed with two plastic standoffs similar to the ones used to hold the CPU PC board.

4.3 We are now ready to install the 4.5" long, 20 pin jumper cable to the FDC-3B/C PC board. CAREFULLY CENTER the pin tips of the 20 pin cable with the connector fingers on the FDC-3B/C PC board bus connector. **If your FDC-3 controller board has the 20 pin jumper soldered to it, you may proceed to Step 4.4.**

While exerting equal pressure on both sides of this cable, press it firmly into the connector until it seats properly. This step may take some doing to accomplish properly. Check for alignment after performing this step. THE IMPORTANCE OF PROPERLY PERFORMING THIS STEP CANNOT BE OVERSTRESSED. Failure to properly perform this step is the biggest problem area in the entire installation; it is the primary reason that the controller may not work properly the first time that you power it up.

4.4 Locate the grey drive cable in the accessories kit. This cable should be installed to the top connector on the FDC-3B/C PC board so that the connector that is farthest from the other connectors is connected to the FDC-3B/C. The colored stripe on the grey cable (pin 1) should be to the outside edge (left side of the computer as viewed from the rear) of the Model-III if you have properly performed this step.

4.5 Locate the controller power cable (it has a red 4 pin, header socket on each end) and connect it to either SK-2, SK-3, or SK-4 on the FDC-3B/C controller board. Route the drive cable, the 20 pin Flex Jumper, and the controller power cable through the opening between the two parts of the metal frame that the CPU PC board is mounted upon. Refer to FIGURE 9-4 to clarify this point.

4.6 You may now reinstall the CPU PC board at this time by reversing the procedure outlined in PARAGRAPH 3.0 above.

5.0 ACCESSORY KIT MOUNTING INSTRUCTIONS

PLEASE REFER TO FIGURE 9-2 FOR THE FOLLOWING STEPS.

MICRO MAINFRAME supplies mounting brackets that are identical in length for both sides. These brackets have holes drilled in the sides to accommodate two floppy disk drives. The holes that mount the brackets to the TRS-80 are either slightly oversized or slotted (this may vary between vendors) to provide a limited amount of adjustment to allow for manufacturing inconsistencies in the Radio Shack case. With this feature, you can now adjust the drives for a perfect match to your particular case.

5.1 Turn the Model-III computer so that you are facing the Keyboard. On the right side of the computer just behind the keyboard, locate the drive mounting area (four holes in a rectangle spaced about 6" apart). REFER TO FIGURE 9-5 FOR THE LOCATION OF THESE HOLES. The proper mounting holes will have threaded brass nuts imbedded into the plastic.

5.2 Take one of the mounting brackets and install it on the right side of the drive mounting area using the 8-32 x 3/8" screws and washers provided. For Tandon drives, slide the brackets all the way forward towards the front of the computer. For MPI drives, slide the brackets all the way back toward the rear of the computer. DO NOT EXERT EXTREME FORCE WHEN TIGHTENING THE MOUNTING SCREWS, AS IT IS POSSIBLE FOR YOU TO STRIP OUT THE BRASS NUTS.

5.3 Install the remaining bracket on the left side of the drive mounting area in the same manner as STEP 5.2 above.

5.4 If you purchased the SPS-1 power supply from Micro Mainframe it is a switching power supply. Locate the two white plastic Ty-Wraps (TM) included with your installation kit. We will use these plastic straps to mount the SPS-1 power supply to the bottom of the Model-III case (please refer to FIGURES 9-2A, 9-2B, & 9-2C for the location and mounting procedures). Loop the Ty-Wrap as shown in FIGURE 9-2C at the locations denoted in FIGURE 9-2B.

If you purchased a power supply from your dealer, you should determine what type of power supply he has provided. The vendor should have provided you with some instructions as to where to mount the power supply. If he has provided an Astec switching power supply, you should mount it identically as for the MICRO MAINFRAME power supply noted above. If you purchased a linear power supply, you may not be able to mount it under the CRT due to size limitations or possible video interference due to the magnetic flux of the transformer. Check with your dealer if you have questions regarding your particular installation.

5.5 POWER SUPPLY CONNECTIONS

PLEASE REFER TO FIGURES 9-6, 9-7, 9-8 & 9-9 FOR THE FOLLOWING STEPS.

1. Locate the white power connector in the Model-III wiring harness. It has one black and one white wire and is usually secured with a white plastic strap. Cut the plastic strap with some diagonal cutters ("dikes").
2. Connect the cable from Step 1 to the SK-1 connector on the power supply. This plug supplies the 115 volt AC current to the power supply and it will not work without this connection. MAKE CERTAIN THAT THE BLACK WIRE GOES TO THE TERMINAL MARKED "L" AND THE WHITE WIRE GOES TO THE TERMINAL MARKED "N" ON THE SPS-1 POWER SUPPLY.

3. Locate the controller power cable (Refer to Step 4.5 above) and connect the free end (it has a RED connector) to either socket SK-2, SK-3, OR SK-4 on the switching power supply. MAKE ABSOLUTELY CERTAIN THAT IT IS CONNECTED AS SHOWN IN FIGURE 9-7 OR YOU COULD BURN OUT BOTH THE SPS-1 POWER SUPPLY AND THE DISK CONTROLLER. MICRO MAINFRAME WILL NOT REPLACE UNITS DETERMINED BY US TO HAVE BEEN DAMAGED BY INCORRECTLY CONNECTING ANY OF THE CABLES. If you do not have a switching power supply you should refer to the instructions provided by the dealer providing the power supply.

4. Locate both of the drive power cables in your accessories kit and connect the RED connectors to any two of the remaining four position connectors on the power supply.

5. Verify that JU-1 on the power supply is connected to the correct pin for your AC supply voltage. Please refer to FIGURE 9-6 for the location of this jumper. As shipped from the Factory, JU-1 is connected to the 115 VAC position denoted as A in FIGURE 9-6. If your power source is 230 VAC (foreign operation only), then reconnect JU-1 to position B. PLEASE NOTE: YOU WILL HAVE TO MAKE THIS CHANGE ONLY IF YOU LIVE OUTSIDE OF THE USA AND YOUR POWER IS 230 VAC.

6. THIS COMPLETES THE CONNECTIONS TO THE POWER SUPPLY.

6.0 DISK DRIVE CONFIGURATION PROCEDURE

PLEASE REFER TO FIGURES 9-10, 9-11, & 9-12 FOR THIS STEP.

You must now prepare your disk drives for the installation by configuring them for Drives 0 and 1 respectively. Before performing this operation, you should check the documentation supplied by the drive manufacturer (usually, but not always included with your drives by the dealer). If he did not supply the documentation, you may refer to FIGURES 9-10, 9-11, or 9-12 for a outline drawing of how to configure MPI, Tandon, or TEC disk drives. We have included diagrams for these types of drives since they seem to be the most popular of all the drives used for Model-III upgrades. If you are using another type drive, you are on your own if your dealer cannot help you. MICRO MAINFRAME CANNOT PROVIDE INFORMATION FOR ANY OTHER TYPES OF DRIVES.

A shunt merely means a SHORT circuit (or connection) between two points in a circuit. Most drives are supplied with one of two types of SHUNT. MPI and TANDON drives come with 14 pin plastic package (DIP SHUNT) that resembles a 14 pin Integrated Circuit that has a piece of metal shorting across from one side to the other. The easiest way to program this shunt is to remove the DIP SHUNT from its socket, determine which 2 out of the 7 connections that you want shorted, and then bend one side of the connection up for each connection that you want to be open. FIGURE 9-13 IS REPRESENTATIVE OF THIS TYPE OF PROGRAMMING.

The second type of SHUNT supplied is a small piece of plastic that slips over two adjacent pins of a HEADER SOCKET. This is the method used with the TEC disk drive. It is also very simple to perform this operation, as one merely removes the SHUNT from the position in which it was shipped, and reinstalls it in the desired position. This is a much faster programming operation than with the other type.

1. Locate the TERMINATING RESISTOR package for each drive in your system. PLEASE REFER TO FIGURES 9-10, 9-11, OR 9-12 FOR THE LOCATION OF THIS RESISTOR. If you intend to install Drive 0 into the bottom slot of the computer (this is the normal preference), then make certain that the drive that you are going to program as Drive 0 has the terminating resistor installed since it is the last drive on the cable.

2. Remove the TERMINATING RESISTOR package from the remaining drive. This may be accomplished by taking a small screwdriver or nail file and gently prying first upon one end and then the other until the chip pops out of the socket. Save this chip for a spare.

3. We are now ready to program the drives for the desired selection.

   a. If you are using MPI drives, program the **DIP SHUNT** as per **FIGURE 9-10.** Make certain that you have a jumper installed to select the drive and load the head. If you wish to load the head with DRIVE SELECT, then you will want to install a jumper across pins 1 and 16. If you desire to load the head when the motor is turned on (this is the usual choice since the continual loading and unloading of the head can be annoying after awhile), then you should install a jumper across pins 8 & 9. **NOTE:** If you do not make a selection of one of these options, the head will never load and the drive will NEVER read anything from the disk.

   b. If you are using Tandon disk drives, you should program the **DIP SHUNT** as per **FIGURE 9-11.**

   c. If you are using TEC disk drives, you should program the **SHUNT** as per **FIGURE 9-12.** Notice that you only have to move the jumper supplied from set of pins to another. This is by far the most easily configured disk drive as there is only one change to make to reconfigure the drive. **Leave the other SHUNT IN POSITION B as noted in FIGURE 9-12.**

6.1 EXTERNAL DRIVE CONFIGURATION PROCEDURE

1. External drives should be programmed exactly as for internal drives 0 & 1 above, except you should select drives 2 & 3 when programming the drive select. Don't forget to program the head select if you are using MPI drives. You can obtain this information by looking at the Figures referenced previously.

2. You must leave one Terminating Resistor in the last drive on the external cable for the system to work properly.

3. Take the 34 conductor cable extending from your external drive(s) and plug the cable into the 34 pin connector on the bottom of the FDC-3B/C. Radio Shack has provided an access hole for this connector on the bottom of the computer. Make certain that pin 1 on the drive cable (usually denoted by a colored stripe) is to the outside (right side of the TRS-80 as seen from the front).

7.0 INTERNAL DRIVE INSTALLATION PROCEDURE

After you have properly configured and double checked your work, you may install the disk drives into your Model-III. You will probably want to mount Drive 0 as the bottom drive and Drive 1 as the top drive. You will have to purchase eight 6-32 x 3/8" screws for this installation if your drive supplier did not include them. Install the bottom drive first utilizing the following procedure.

1. Connect one of the drive power cables (one end of which is already attached to the power supply) to the bottom drive. The drive power connector is a four position, white connector that plugs into a mating connector on the bottom of the drive PC board. See **FIGURE 9-8** for the pin out on this connector.

2. Install drive 0 into the mounting towers at the bottom position using four of 6-32 x 3/8" screws you have purchased.

3. Install drive 1 into the mounting towers at the top position using four of the 6-32 x 3/8" screws you purchased.

4. Reconnect the video and ground cables to the video monitor board mounted at the left side of the cabinet, and reinstall the top cabinet. Make certain that all wires are inside the case and are not pinched between the top half and bottom half of the cabinet. Check to make certain that the drives are properly aligned in the openings provided. You are now ready to power up and check the installation. This procedure will be further outlined in **Section II.**

8.0 8" DRIVE CONNECTIONS - FDC-3C ONLY

If you desire to operate the 8" floppy disk drives (available only with the FDC-3C), you will have to fabricate a drive cable. Instructions for making this cable will be found in Appendix A. **YOU WILL NEED TO INSTALL A SPEED-UP BOARD IF YOU WISH TO SUPPORT 8" DOUBLE DENSITY DRIVES AS THE 2 MHz. MODEL-III IS INCAPABLE OF CLOCKING OUT DATA FAST ENOUGH TO KEEP UP WITH THE NEEDS OF AN 8" DISK DRIVE.**

In addition to the procedure outlined above and in Appendix A, you will need an operating system that supports 8" disk drives. This is available from Micro Systems Software in Florida. You must purchase DosPlus version 3.4 or later in order to support 8" drives. Apparat does not presently support the FDC-3C with NewDos 80, as their controller uses a different scheme to select 8" disk operation. If you are using **DOSPLUS 3.4 OR 4.0** please use Micro Systems Software's **DISKZAP** program to verify that the following bytes are present. If they are not, then Patch your copy of DOSPLUS by doing the following:

Enter the display mode and display :

Track 0F, Sector 03

Enter the Modify mode by pressing "M" and change the following bytes in that sector :

Byte	From	To
75	00	0F
77	20	30

This concludes the modifications to DOSPLUS to make it work properly with the FDC-3C disk controller board.

9.0 ILLUSTRATIONS AND MISCELLANEOUS INFORMATION

This section contains the illustrations necessary to install the FDC-3 series disk controllers. We have also included the signal assignments for each of the connectors on the FDC-3 controllers to assist in your troubleshooting.

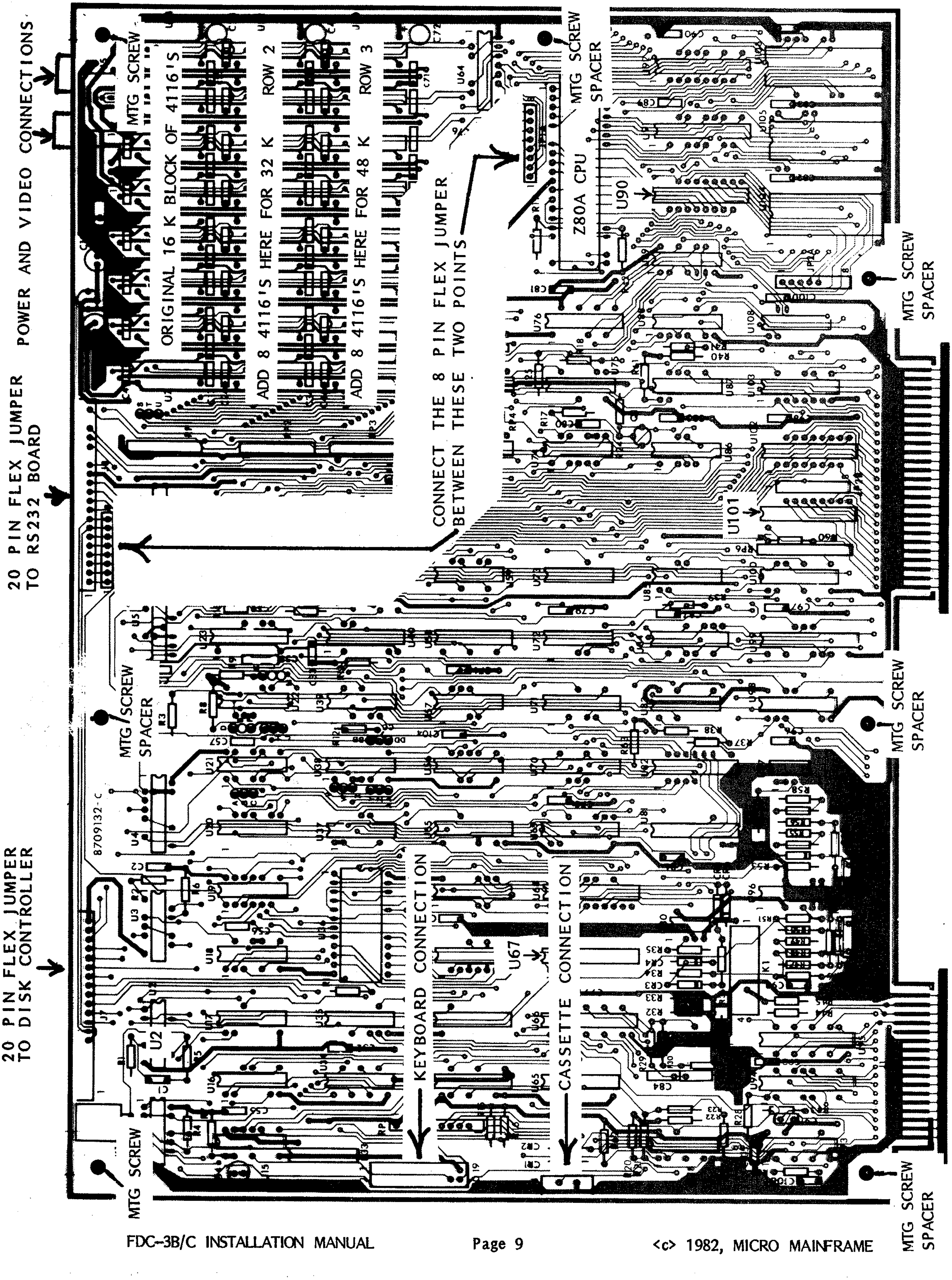

POWER AND VIDEO CONNECTIONS
20 PIN FLEX JUMPER TO RS232 BOARD
20 PIN FLEX JUMPER TO DISK CONTROLLER
MTG SCREW
MTG SCREW SPACER
ORIGINAL 16 K BLOCK OF 4116'S
ROW 2
ADD 8 4116'S HERE FOR 32 K
ROW 3
ADD 8 4116'S HERE FOR 48 K
CONNECT THE 8 PIN FLEX JUMPER BETWEEN THESE TWO POINTS
Z80A CPU
U90
U101
U67
KEYBOARD CONNECTION
CASSETTE CONNECTION
8709132-C
U2

FIGURE 9-1 CPU PRINTED CIRCUIT BOARD

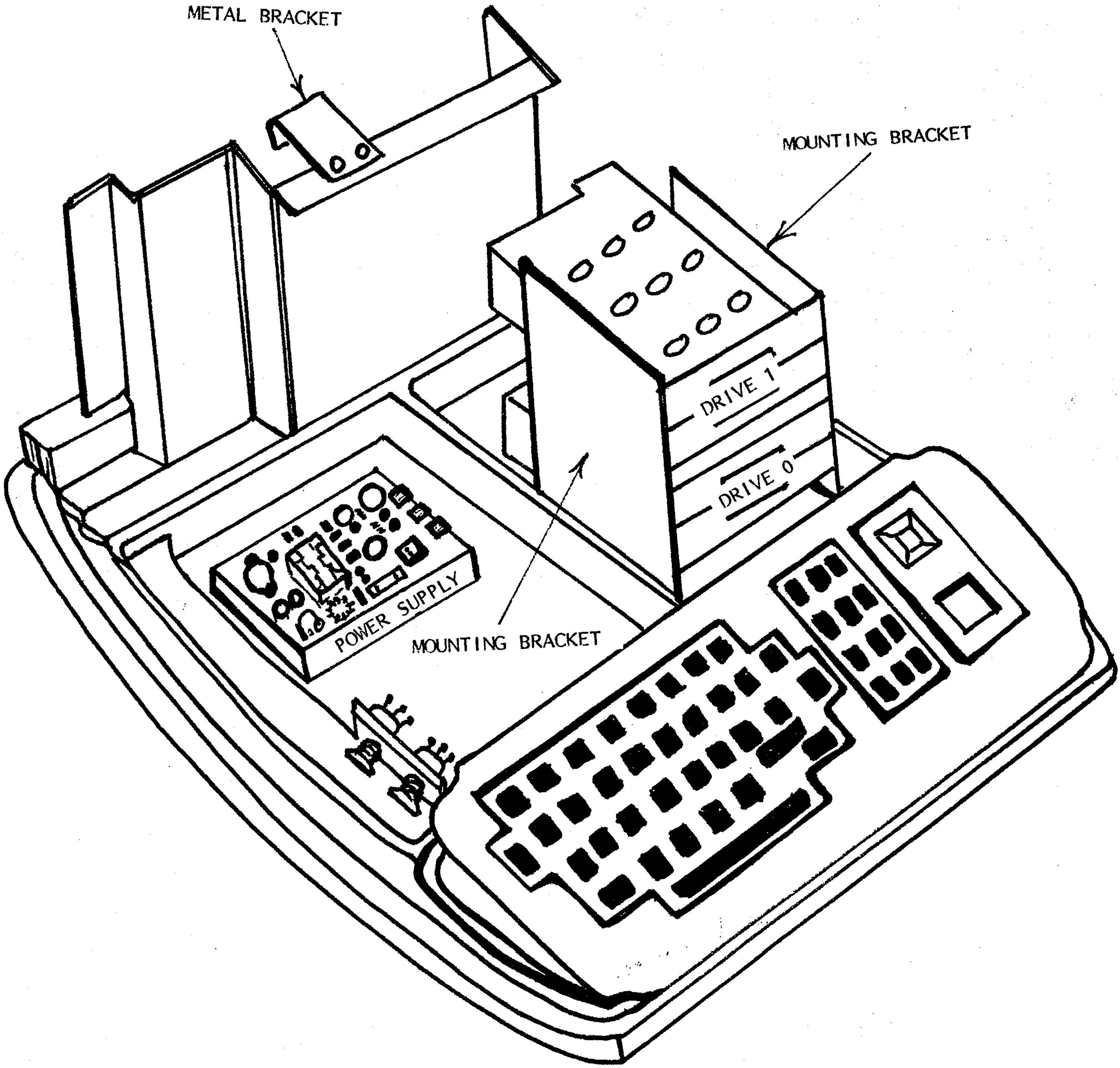
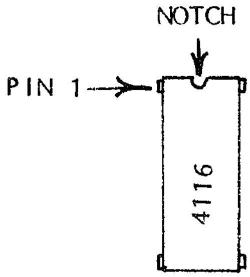


FIGURE 9-2 POWER SUPPLY MOUNTING LOCATION



INSTALL MEMORY CHIPS IN THE 2ND & 3 ROWS MAKING CERTAIN THAT THEY ARE ORIENTED AS SHOWN

FIGURE 9-3 MEMORY INSTALLATION - CLOSEUP VIEW

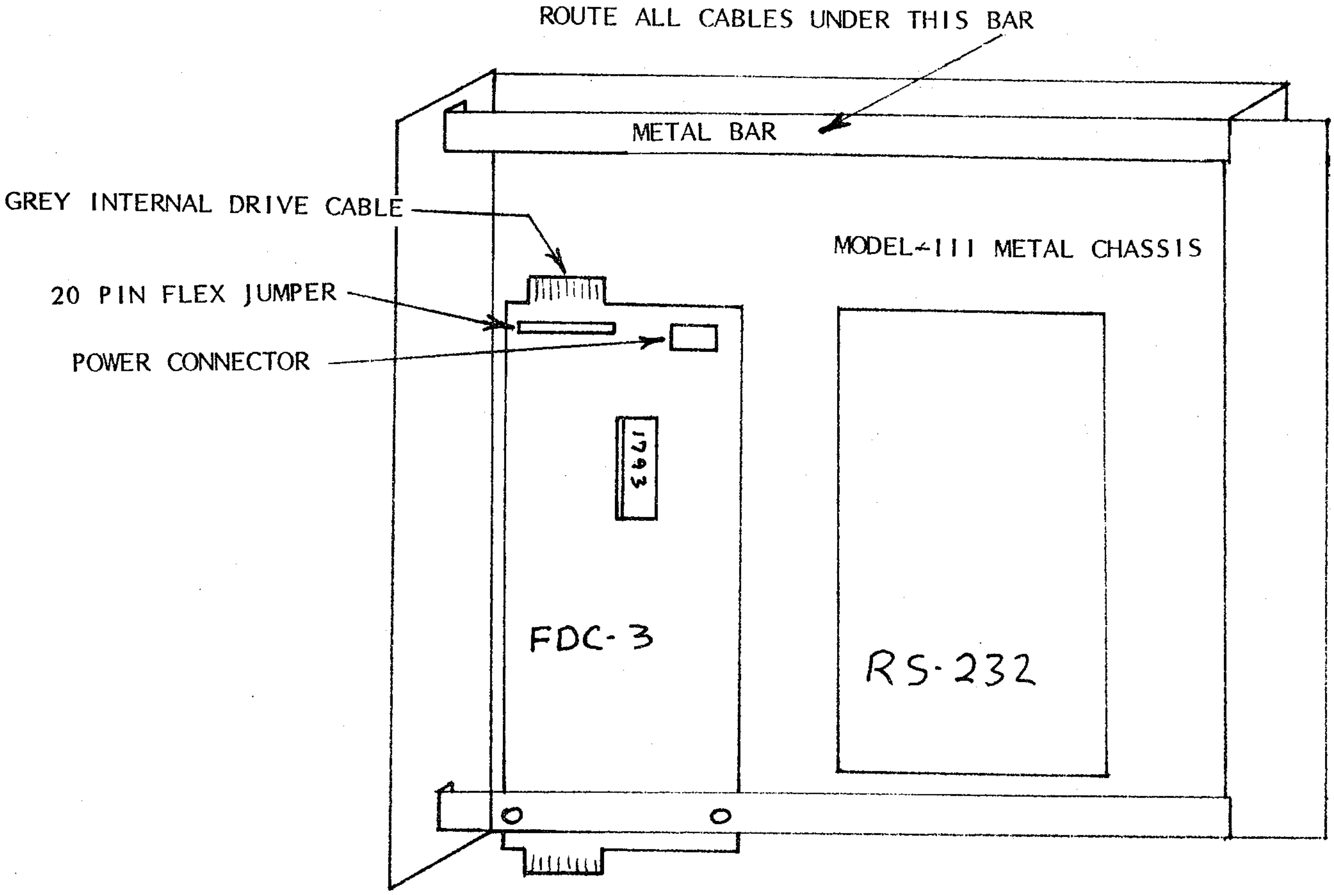


FIGURE 9-4 FDC-3 CONTROLLER LOCATION

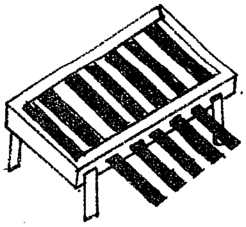


FIGURE 9-13 DIP SHUNT OUTLINE DRAWING

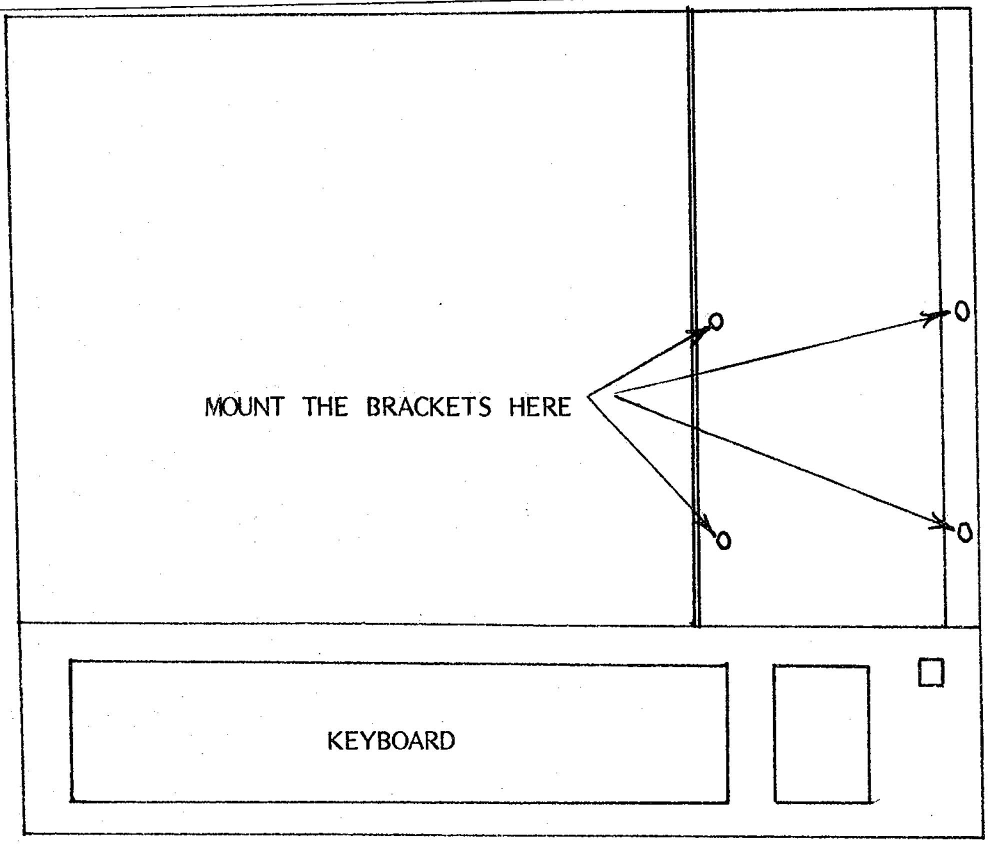


FIGURE 9-5 BRACKET MOUNTING LOCATIONS

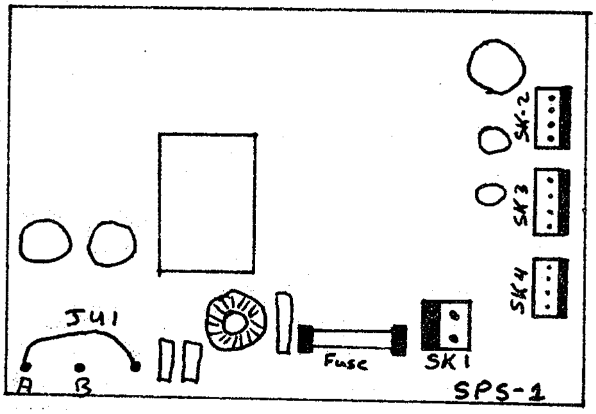


FIGURE 9-6 SPS-1 OUTLINE DRAWING

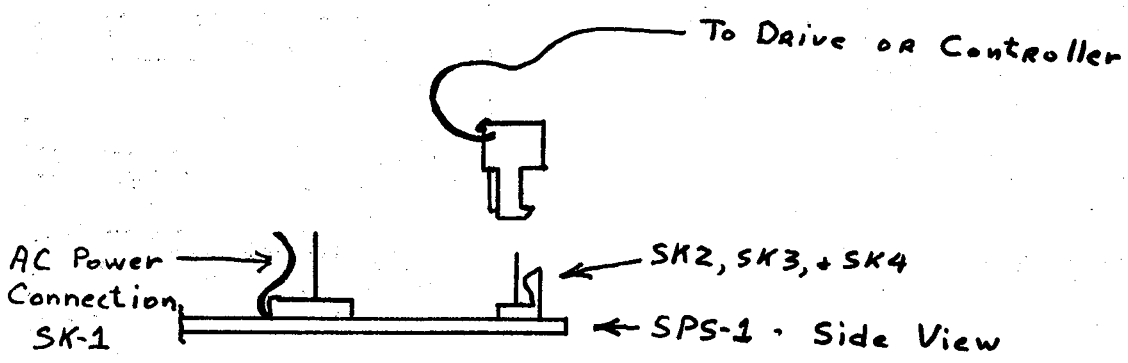


FIGURE 9-7 SPS-1 CONNECTIONS

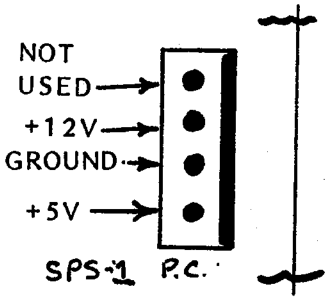


FIGURE 9-8 SPS-1 PINOUT DIAGRAM

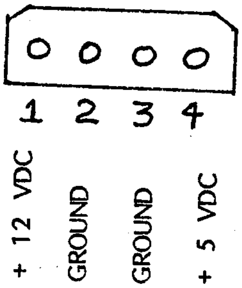
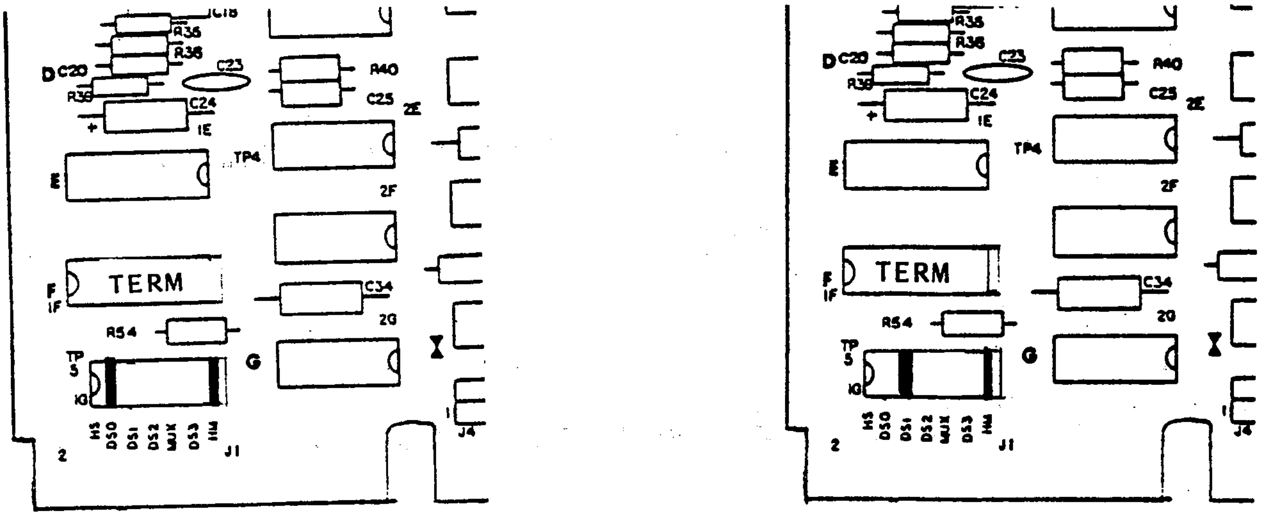


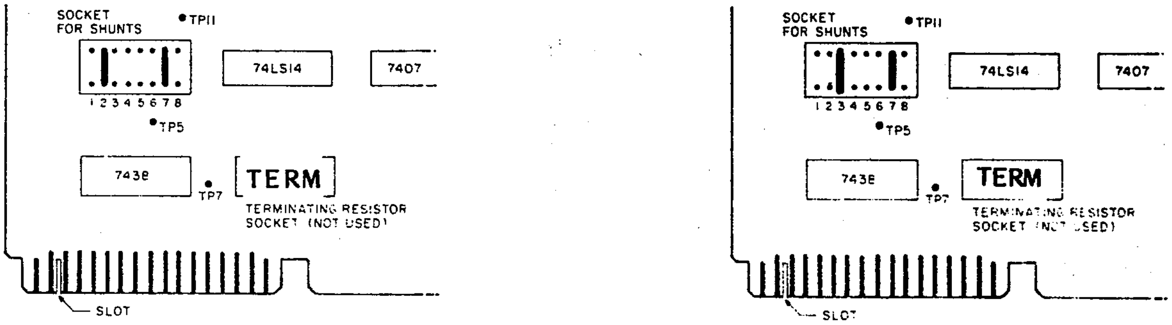
FIGURE 9-9 DISK DRIVE PINOUT DIAGRAM



(A) Drive 0

(B) Drive 1

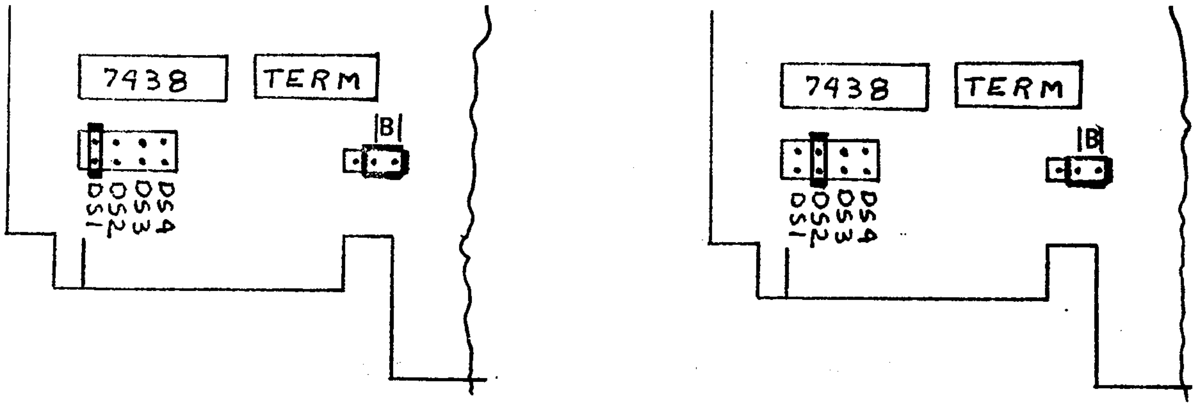
FIGURE 9-10 MPI DRIVE CONFIGURATION



(A) Drive 0

(B) Drive 1

FIGURE 9-11 TANDON DRIVE CONFIGURATION



(A) Drive 0

(B) Drive 1

FIGURE 9-12 TEC DRIVE CONFIGURATION

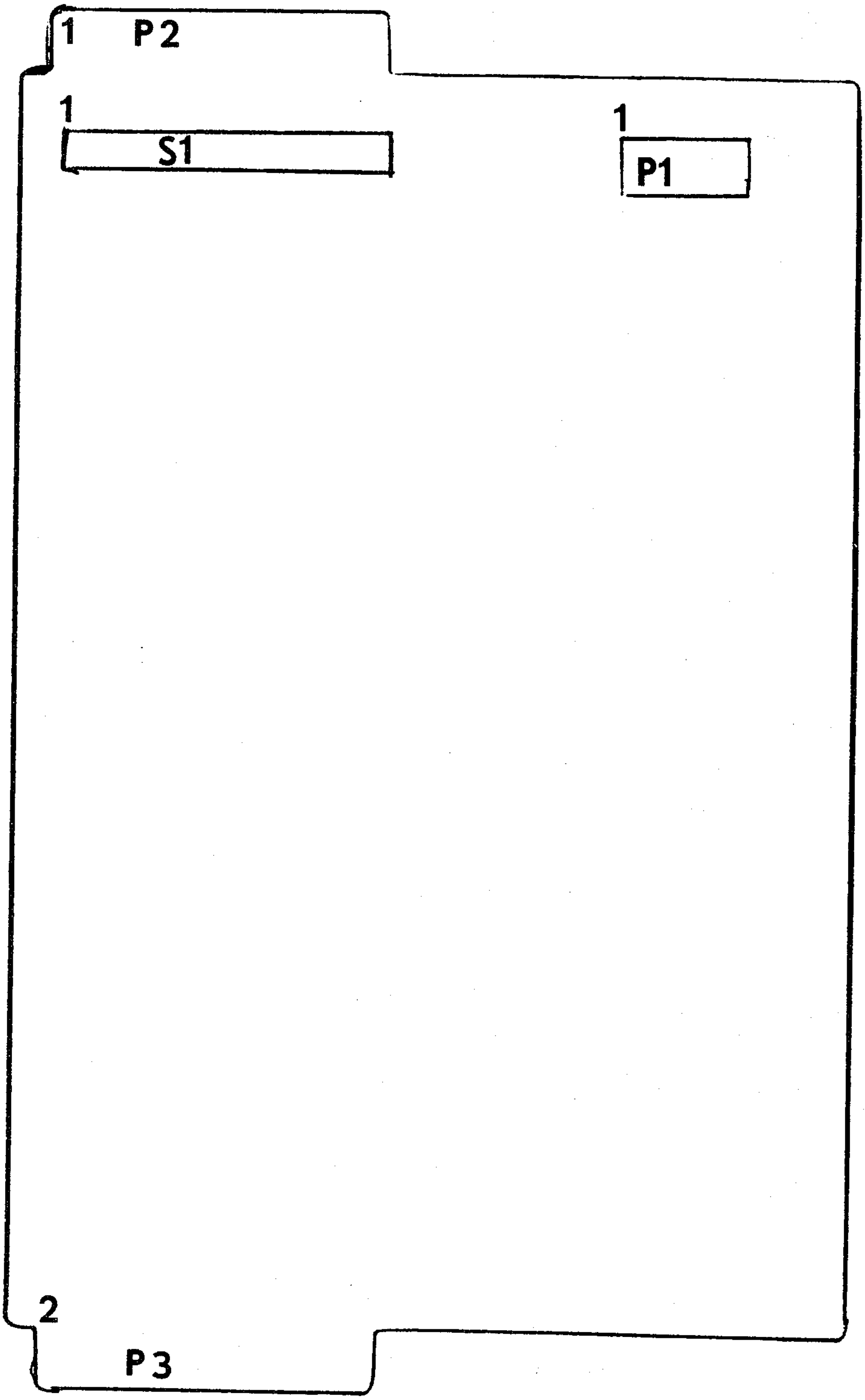


FIGURE 9-14 FDC-3C OUTLINE DRAWING

ANSI DISK DRIVE CONNECTOR PIN ASSIGNMENTS

SIGNAL NAME	PIN NUMBER
SPARE	2
SPARE	4
DRIVE SELECT 4	6
INDEX/SECTOR	8
DRIVE SELECT 1	10
DRIVE SELECT 2	12
DRIVE SELECT 3	14
MOTOR ON	16
DIRECTION	18
STEP	20
WRITE DATA	22
WRITE GATE	24
TRACK 0 DETECT	26
WRITE PROTECT	28
READ DATA	30
SIDE SELECT	32
SPARE	34

All odd numbered pins are at Logic Ground.

The TEC drive model FB-202 does not have connectors for Pins 2, 4, & 34. These drives will work properly although there are only 26 contacts available on the drive.

SECTION II

POWER UP TECHNIQUES AND PROCEDURES

Your FDC-III/C floppy disk controller has been carefully tested and burned in at the factory. Nevertheless, some individuals seem to have difficulty with the installation. Experience has shown that very few individuals understand the principals involved in disk operation, and are, therefore, unable to troubleshoot the system when it does not appear to work properly.

The following information when used in conjunction with the theory of operation presented in the operations manual **(AVAILABLE FOR $14.95 FROM MICRO MAINFRAME)** will provide the user with the tools necessary to localize his problem. The information is presented in a logical sequence and it is recommended that the steps be followed in order. The section on problems with the Model-III computer has been compiled from two years of data from the field and various other sources.

1.0 MAJOR KNOWN PROBLEMS WITH THE MODEL-III COMPUTER

1. TANDY HAS CONTINUALLY HAD A MASTER CLOCK PROBLEM.

   The various revisions of the Model-III CPU card have been modified by TANDY in an attempt to eliminate this problem. The revision number is found in the top center of the board and will be either C, F, or G. The F revision has more capacitance in the master clock circuit to load down and filter the master clock to an approximate sine wave of 2V peak to peak. The 74LS04 (U2) frequently is unable to put out enough current to drive the system, causing the sine wave to warp, jitter, or have less than 2V peak to peak. R1 and R5 just above and below U2 have been changed from 910 ohms to 560 ohms in order to correct this on the G version board and on some F version boards. Resistors tend to increase in value over a period of time, causing the 910 ohm resistors to become more troublesome. **The symptoms are that the computer resets or locks up intermittently; also, the video may flicker. If you have an F version board, you should change the resistors.**

   Check your PCLOCK signal at U62-8.It should be at least 1 volt peak to peak. If the level is low, then Q1 on the CPU is usually defective. PCLOCK must be a decent square wave. A sine wave will not drive the Z80, especially on power up. If the square wave is poor, then replace U62 on the CPU card.

2. GROUNDING AND SHIELDING PROBLEMS (NOISE)

   In some Model-III computers, Tandy ran a ground wire from the left rear, under the CRT to the drive power supply. This wire can act like an antenna and pick up noise from both the video and the Switching power supply. If you have one of these units, you will probably want to re-route this wire away from these noisy areas. Tandy has also had problems with the shield under the video board, as it tends to come loose and short out the video board. The flexible metallic RFI shielding at the bottom of the CPU card has also been known to short out some of the CPU circuitry. Please make certain that you have none of these problems.

3. CONNECTOR PROBLEMS

   Tandy has had problems with the crimps on the Video and Power connectors. These can cause the machine to re-boot in the middle of some critical operation. You may sometimes be able to create this condition by rapping the Model-III case on the top left rear of the case while performing disk I/O. Tandy has previously recommended stripping and soldering the wires into the connector. If you do this, make certain that you get the wires into the right position on the connector.

   Tandy has had three different types of connector on the Model-III for the disk expansion and the RS-232 expansion ports. The early units were white and had contacts on both sides of the connector. The later units had a black connector with only a single row of contacts. These connectors sometimes warp during soldering and will sometimes make it impossible to make a good solid connection. Units with these connectors have been shipped with some or all of the connectors shorted together, or even with some of the connections missing. The latest computers now have connectors with contacts on both sides, but can exhibt the same problems as the black connectors with the single row of contacts.

4. INCOMPLETE TESTING BY TANDY FACTORY

   THE CPU BOARDS ARE NOT TESTED FOR ADDITIONAL RAM, RS-232, or DISK DRIVE OPERATION BY THE FACTORY! Some of the problems regarding the installation of any or all of these features by the individual will appear to have insurmountable problems that are generally considered to be the problem of the company manufacturing the disk drive controller. You could have defective RAM decoding, Port decoding, or the disk drive and/or RS-232 connectors could have missing connections or even traces on the CPU PC board.

2.0 POWER UP PROCEDURE

1. After verification that all connections have been made correctly during the installation, you may apply power to the computer while the top is still off of the Model-III computer.
2. Open the doors of both disk drives and turn on the power switch. The CRT screen should now show either DISKETTE? or CASS? If it does not, then you have probably forgotten something or connected something incorrectly. TURN OFF THE POWER IF THIS IS THE CASE AND RE-CHECK EVERYTHING.
3. If the word DISKETTE? appears on the CRT screen, insert a diskette containing an Operating System (NOT SUPPLIED BY MICRO MAINFRAME) into the drive that you have programmed as Drive 0 and close the door. The RED LED and the spindle motor on the disk drive should turn on, and the disk should rotate. If this happens, the disk should boot up and you should see the logo of the company that produced the Operating System followed by the prompt TRSDOS READY, NEWDOS80 READY, or DOS PLUS. IF YOU DO NOT HAVE AN OPERATING SYSTEM, WE RECOMEND THAT YOU GO TO RADIO SHACK AND PURCHASE TRSDOS AND THE ACCOMPANYING MANUAL.

Although TRSDOS lacks some of the features found in some of the more esoteric operating systems, we feel, nevertheless, that the user must become familiar with the basic procedures of TRSDOS. The RADIO SHACK manuals are an excellent introduction to DISK OPERATION and DISK BASIC. This is not always true of the manuals supplied with the more esoteric operating systems. In fact, most of them are impossible to understand without at least some familiarity with TRSDOS procedures.

If your disk controller unit appears not to operate properly, the information and test routines provided below should help you determine the nature of your problem. These routines will work from either ROM BASIC or DISK BASIC. If your controller appears to be inoperative, you can enter ROM Basic by holding down the <BREAK> key and pressing the RED <RESET> key. Answer all questions with an <ENTER>.

1. We should first determine whether the CPU recognizes the controller on the bus. This may be accomplished by typing the following statement from the keyboard:

```
PRINT INP(240)
```

   If the disk controller is there, the FDC will return a status of 128 decimal (80H) indicating that the controller is there, but not ready. This is the desired status at this time, and its presence indicates that your 20-pin bus connector is probably connected properly. If the returned status is 255, then you either have forgotten to connect power to the controller or your power supply is defective.

2. We should now determine if we can select drive 0. This is accomplished by typing the following statement from the keyboard:

   ```
   OUT 244,1
   ```

   This command should turn on the drive spindle motor and the **RED LED** for approximately 3 seconds. You may select Drives 1, 2, and 3 by changing the 1 to 2, 4, or 8 respecively. Obviously, you will be able to select these additional drives only if you have them installed in the system.

3. If your controller passes the tests outlined above, you have apparently installed the controller correctly. You should now insert a TRSDOS diskette and hit the RED **<RESET>** button on the Model-III keyboard. If all is well, you will get the Tandy logo on the screen and you will be asked to supply the date and time. Please respond accordingly.

4. You should now familiarize yourself with the Operating System that you will be using and attempt to make a backup of your master diskette by following the procedure outlined in the DOS Manual (supplied by DOS vendor).

5. If you are still having problems, then please refer to **SECTION III - WHEN THINGS GO WRONG.**

SECTION-III

WHEN THINGS GO WRONG

We have recently discovered that most of the strange problems people have had upgrading Model-III computers to disk operation may be completely eliminated by replacing three of the chips on the CPU PC board. These chips are either 74LS245 or 74LS645 parts (both are interchangeable) and are usually manufactured by Motorola. Fortunately, all three of these chips are in sockets (Tandy probably knew that this was a problem area all along). Try to replace these chips with those made by Texas Instruments if possible, as these seem to perform the best. Other problems have been fixed by replacing the Z80 CPU with a Z80A CPU. LATE FLASH - THE LATEST G VERSION BOARDS FROM TANDY ARE BEING SHIPPED WITH A Z80A CPU, SO PLEASE TRY THESE CHANGES

SCREEN DISPLAYS GARBAGE

This problem is generally related to the problem with the 74LS245's mentioned above. Try to replace U67, U90, & U101 before going into AutoPanic. The usual symptom is that the screen displays random characters after a reset. First press <RESET> several times; if the system still displays garbage, then one or more of the floppy disk controller data lines or control lines could be shorted. Check for shorts and solder bridges on the 20 pin connector (S1 1-20) on the FDC-3 controller board. If none are found, check the connector on the Model-III computer board. Believe it or not, Tandy has shipped out units with shorted connectors or in some cases, most of the connections missing. Naturally, this would make it impossible for anyone but Tandy to upgrade to disk operation. If you discover that this is your problem, Micro Mainframe can supply a spare connector for $2.50 plus shipping and handling charges. If you have none of the problems outlined above, reinstall the 20 pin jumper cable going from the CPU board to the floppy disk controller and press <RESET>; if the screen still displays garbage, call MICRO MAINFRAME CUSTOMER SERVICE for further assistance.

SCREEN DISPLAYS 'CASS'

SEE FIGURES 9-8 & 9-9 FOR PINOUTS.

- Check for +5vdc on the floppy disk controller (P1-1)
- Check for +12vdc on the floppy disk controller (P1-3)
- If there is no voltage then the power supply or the power cable is defective.

First press <RESET> several times; if the system still displays 'CASS' press <RESET> and <BREAK> at the same time to get into ROM BASIC. Then type ?INP(240) and hit <RETURN>. The 240 in the input statment is the decimal equivalent of the FDC COMMAND/STATUS regiser located at PORT 0F0H. THE FDC STATUS SHOULD BE 128; IF IT IS ANYTHING OTHER THAN 128, REMOVE AND REINSTALL the 20 and 34 conductor cables going from the drives and CPU to the floppy disk controller. Press <RESET> and check the FDC status register again, if this value changed from the previous value, one of the following conditions could be causing the problem: one of the cables is probably defective; the 20 or 34 conductor cable is still connected wrong; one or more of the conductors on the cables is shorted; or one or more of the Control/Data bits 0-7 (S1-1to20) on the floppy disk controller bocrd are shorted together. Please refer to the discussion on SCREEN DISPLAYS GARBAGE noted above and check everything mentioned, especially the connectors on the Tandy PC board. If the status register returns 255, then you are not getting power to the FDC-3 controller board. You should check the power connector on the FDC-3 printed circuit board (See FIGURES 5.4 & 5.6) for the correct voltages. If you cannot make the FDC status register return 128 then call MICRO MAINFRAME CUSTOMER SERVICE FOR ASSISTANCE.

DRIVE 0 MOTOR AND LED DO NOT COME ON

Reinstall both drive cables going to the floppy disk controller board and press <RESET>. If drive 0 still does not come on, make sure drive 0 is configured properly (check your drive Owner's Manual or FIGURES 9-10, 9-11, or 9-12 for drive configuration procedures). Enter BASIC by pressing the <RESET> and <BREAK> key at the same time, and type OUT 244,1. This should turn on the RED LED and the drive spindle motor for Drive 0. If this does not work then type OUT 244,255. If you have made an error in the oonfiguration procedure, this will turn on any drive position that you have selected in error. If nothing happens, you may have forgotten to install the DIP SHUNT. If none of the above fixes the problem you should contact MICRO MAINFRAME CUSTOMER SERVICE for assistance.

BOTH DRIVES COME ON SIMULTANEOUSLY AFTER A RESET

Reinstall both cables going to the floppy disk controller board. Make sure drive 1 is configured properly, checking your Owner's Manual if necessary. Enter BASIC by pressing the <RESET> and <BREAK> keys simutaneously. Type OUT 244,1. The RED LED and spindle Motor on drive 1 only should come on. If both drives still come on simultaneously, then the probable cause is one of the following: The disk drive cable cable is defective or shorted; the control lines coming out of the FDC-3 disk controller are shorted or open; the disk drive is defective; or your DIP SHUNT or TERMINATING RESISTOR programming is incorrect. If none of the above fixes the problem you should contact MICRO MAINFRAME CUSTOMER SERVICE for assistance.

DRIVE 0 STAYS ON CONTINUOUSLY

Remove and reinstall the 34 conductor disk drive cable going from the floppy disk controller to the disk drives. Configure drive 1 to be drive 0 (don't forget the DIP SHUNT PROGRAMMING) so both drives will now be drive 0 and hit <RESET>. If both drives come on continuously and your configuration is correct (this includes TERMINATION RESISTOR PLACEMENT) then probable causes are: a defective disk drive; some of the control lines on the FDC-3 are shorted, or the Drive Cable (Grey cable) is shorted. Try replacing the 34 conductor disk cable to correct the problem.

DOS WILL NOT BOOT UP OR LOAD A FILE

Make sure the copy of the DOS you are using is good. Push the READ/WRITE head on the disk drive towards the front of the drive approximately one inch; hit <RESET> and see if the disk drive read/write head restores (moves back to the outside track of the diskette). Exercise CAUTION here as you could damage the disk drive. Disconnect drive 0 and configure drive 1 as drive 0 then try a single drive backup. If this works, drive 0 is probably at fault. If none of the above fixes the problem you should contact MICRO MAINFRAME CUSTOMER SERVICE for assistance.

DOS WILL NOT FORMAT OR MAKE A BACKUP

Exchange drive 0 with drive 1 (don't forget the DIP SHUNT and TERMINATION RESISTOR programming) and retry the backup. Try a single drive backup on both drives. If the problem disappears, the disk drive is probably at fault. If none of the above fixes the problem you should contact MICRO MAINFRAME CUSTOMER SERVICE for assistance.

DISK DRIVE WILL NOT FORMAT PAST TRACK 22

Make sure the copy of the DOS you are using is good. Use a good brand of certified diskettes to format or make a backup on. Try a format on both Drive 0 and Drive 1 (PLEASE DONT FORMAT OVER YOUR OPERATING SYSTEM DISKETTE). If one drive formats properly and the other one doesn't, then you probably have problems with one of your disk drives. Try to borrow another disk drive from a friend and try it on your system. If no drive will format beyond track 22, then you may need to purchase a MICRO MAINFRAME DS-1A data separator to work in conjunction with your FDC-3B controller (this is not required for use with the FDC-3C controller as it already has the DS-1A data separator incorporated into the circuit.

Your Disk Drives may be exhibiting excessive bit shift and not be performing properly on the inner tracks. Have your disk drive checked for head compliance, proper track 0 detect, and radial alignment. Data jitter translates into data instability due to the drive speed varying sharply in a short period of time. Probable causes are a defective drive belt, drive motor, or spindle bearing. One additional factor may be that the high voltage RF pulse that provides Horizontal Deflection on your CRT may be interfering with the data separator due to excessive radiation. We have experienced several reports from the field that this RADIO FREQUENCY INTERFERENCE can put a pulse so large into the head of the disk drive that the data separator is unable to take it out. This causes errors to be detected and the drive will cease to function properly. Some individuals have solved this problem by installing a shield around the disk drive. Some have reported using tin foil with good results while others have reported that they had to use galvanized sheet metal shields to eliminate the problem. If you do any method of shielding, exercise caution to insulate the metal from the circuit board, or you can burn up a disk drive. If none of the above fixes the problem you should contact MICRO MAINFRAME CUSTOMER SERVICE for assistance.

This completes the TROUBLESHOOTING SECTION.

APPENDIX A

A.0 8 INCH DISK OPERATION

In order to implement 8 inch disks on your FDC-3C disk controller, you will have to build a special cable. This cable will effectively translate the 34 pin cable required for the 5" disk drive to the 50 pin cable required by the 8 inch disk drive. All of the 8 inch selection logic is already present on the FDC-3C disk controller, but you will have to use an operating system designed to work with this controller such as DOS Plus 3.4 or greater.

A.1 CS-5 CABLE ASSEMBLY - PARTS REQUIRED

1. 50 pin card edge connector (1 required for each 8" drive).
2. 34 pin card edge connector (1 required).
3. 34 conductor ribbon cable (maximum length of 10 feet).

A.2 CS-5 ASSEMBLY INSTRUCTIONS - PLEASE REFER TO FIGURE A-1

1. Locate the colored stripe designating line 1 on the 34 conductor cable and align it so that it will go to Pin 1 of the 34 pin card edge connector. MAKE ABSOLUTELY CERTAIN THAT YOU HAVE EACH OF THE INDIVIDUAL CONDUCTORS OF THE CABLE PROPERLY ALIGNED WITH EACH OF THE PINS OF THE CONNECTOR. When all is correct, crimp the connector together using a small vice or press to make the crimp.
2. The 50 pin connector will be assembled differently.
   a. Locate the following wires in the 34 conductor cable and peel them out of the cable so that they are 2" long: Wire Numbers 2,4,6,8,16,32, and 34 will be pulled back and separated from the remainder of the cable. DO NOT CUT THESE WIRES, AS WE MUST RECONNECT THEM TO DIFFERENT PIN NUMBERS.
   b. **While keeping these wires pulled back and out of the way, align the remaining lines of the cable as shown in FIGURE A.1** so that Line 1 goes to Pin 18 and line 33 goes to Pin 49 of the 50 Pin connector. MAKE CERTAIN THAT EACH OF THE INDIVIDUAL CONDUCTORS IS PROPERLY ALIGNED WITH EACH OF THE PINS OF THE 50 CONDUCTOR CABLE AND CRIMP THE CONNECTOR TO THE CABLE AS ABOVE, MAKING CERTAIN THAT THE 34 CONDUCTOR CABLE EXTENDS BEYOND THE OPPOSITE SIDE OF THE 50 PIN CONNECTOR AT LEAST 1.5 INCHES.
3. Carefully remove the back portion of the previously crimped 50 pin card edge connector with a knife. Some connectors are easily destroyed, so take extra caution for this step.
4. Make the following connections with the lines you have just removed in STEP 2.b above.
   a. Connect Line 2 to Pin 22.
   b. CUT LINE 4.
   c. Connect Line 6 to Pin 32.
   d. Connect Line 8 to Pin 20.
   e. Connect Line 16 to Pin 18.
   f. Connect Line 32 to pin 14.
   g. CUT LINE 34.
   h. Replace the back portion of the 50 pin card edge connector and re-crimp.
   i. PERFORM THIS OPERATION FOR EACH OF THE 50 PIN CARD EDGE CONNECTORS YOU WISH TO USE (TO A MAXIMUM OF 4). THIS COMPLETES THE ASSEMBLY OF THE CS-5 CABLE.

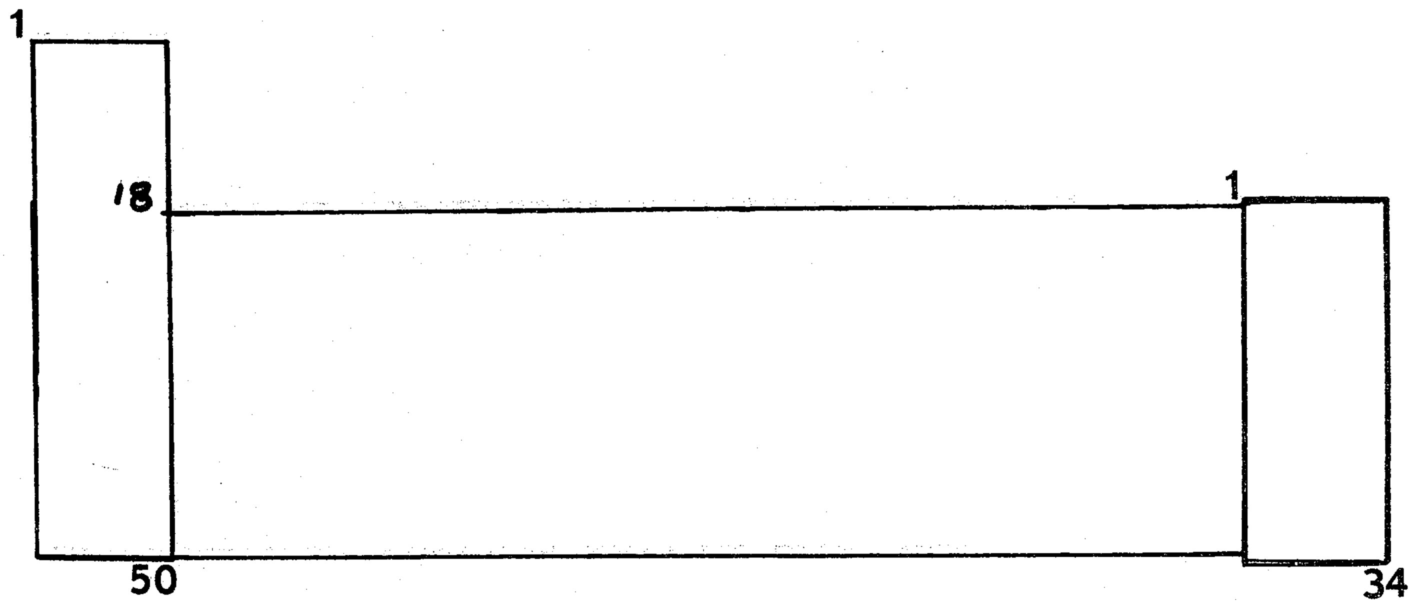


FIGURE A.1 8 INCH DRIVE CABLE ILLUSTRATION